Chapter F1: Introduction

CHAPTER CONTENTS

This report presents the results of an evaluation by EPA to assess the potential benefits of reducing the impacts of impingement and entrainment (I&E) at cooling water intake structures (CWIS) at the Brayton Point Station located on Mount Hope Bay in the Town of Somerset, Massachusetts across the mouth of the Tauton River from the city of Fall River. Mount Hope Bay in an upper embayment of Narragansett Bay. It is an interstate water comprising waters of both Massachusetts and Rhode Island.

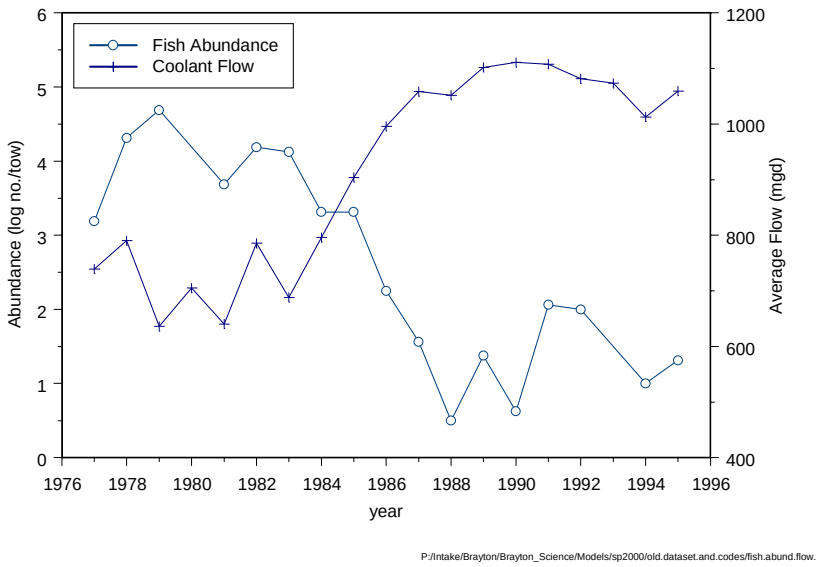
With a capacity of 1,611 megawatts, Brayton Point Station is the largest fossil fuel burning steam-electric generating facility in New England. The station uses a once-through-cooling water system and is allowed by its current NPDES permit to withdraw up to 1.452 billion gallons a day (BGD) of cooling water from Mount Hope Bay and then discharge the heated water back into the Bay at temperatures up to 22 ˚F above ambient water conditions. The current National Pollution Discharge Elimination System (NPDES) permit expired in June 1998, and EPA Region 1 is currently developing conditions for a new NPDES permit. EPA co-issues this permit with the Massachusetts Department of Environmental Protection. EPA must also coordinate permit issuance closely with Rhode Island because its waters are also affected by the plant and the permit must ensure that both Massachusetts and Rhode Island water quality standards are satisfied.

Similarly, both states' Coastal Zone Management Programs must be satisfied, along with the federal Essential Fish Habitat program and other federal requirements. Other significant environmental issues at Brayton Point Station include development of plans to attain compliance with the tough, new state air regulations, possible assessment of compliance with Clean Air Act new source review requirements, on-site coal ash management, and concerns in neighboring Freetown where coal ash from the plant has been landfilled and allegedly contaminated groundwater.

There has been a significant amount of controversy about the plant because of the documented collapse of fish populations in Mount Hope Bay, an interstate water straddling the Massachusetts/Rhode Island state line, and the debate over the power plant's role in causing or contributing to the fishery decline. On October 9, 1996, Rhode Island Department of Environmental Management (RI DEM) issued a report which documented an alarming, sharp decline in abundance of finfish populations in Mount Hope Bay that appeared to occur about seventeen years ago with no subsequent recovery in evidence. Additional review of the data has suggested that the fishery decline actually began, albeit at a gentler pace, before the sharp decline evidenced around 1985. Adverse effects of plant cooling system operations on aquatic organisms can be divided into the following major categories: a) cooling water intake *entrainment* of fish eggs and larvae and other small organisms into the plant's cooling system; b) cooling water intake *impingement* of larger organisms on the intake screening systems; and c) discharge-related effects from the impacts of the thermal effluent on the aquatic community and its habitat. Entrainment and thermal discharge appear to be especially significant issues for this plant, with impingement appearing to be a relatively less major problem.

Figure F1-1 by RIDEM shows annual changes in the aggregate catch per tow for 21 fish species in Mount Hope Bay in relation to changes in total Brayton Point intake flow for 1977 through 1995 (Gibson, 1996). Analysis of these data indicated a statistically significant decreasing trend over time in Mount Hope Bay fish abundances ($p < 0.01$), with the decline averaging 16 percent per year (Gibson, 1996). Moreover, declines in 4 of the species analyzed by RIDFW (winter flounder (*Pleuronectes americanus*), windowpane (*Scophthalmus aquosus)*, tautog (*Tautoga onitis*), and hogchoker (*Trinectes maculatus*)) were significantly greater in Mount Hope Bay than in the rest of Narragansett Bay.

Figure F1-1: Time Series of Annual Mean Coolant Flow at Brayton Point Station and Aggregate Fish Abundance (21 species) in Mount Hope Bay



Sources: Gibson, 1996; personal communication, Meredith Simas, Environmental Engineer, Brayton Point Station, March 23, 2001.

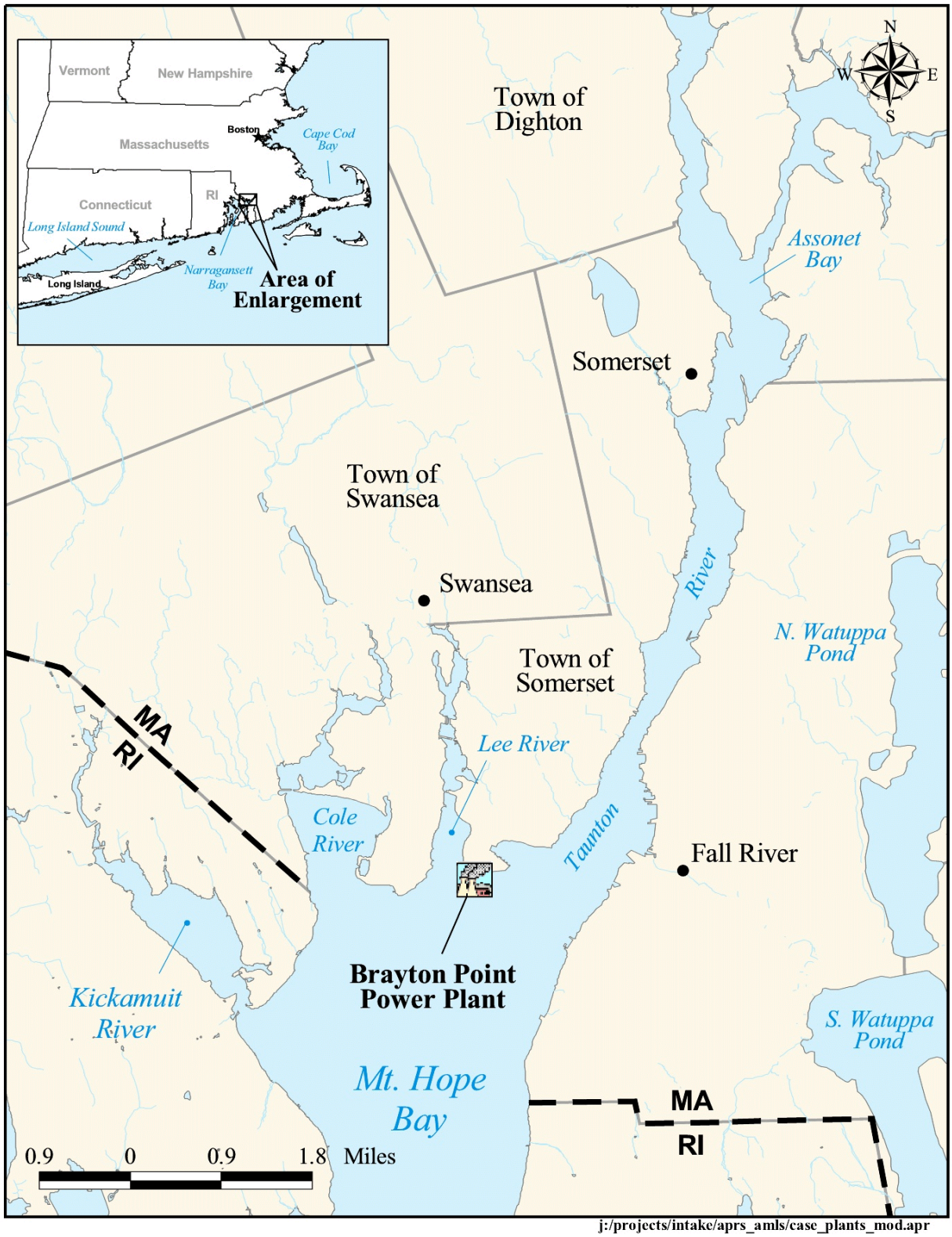
A more recent analysis by the RIDEM (Gibson, 2001) attempted to control for other regional stressors that may be contributing to winter flounder declines, including overfishing, increased winter water temperatures, and increased predation on larvae by the shrimp *Crangon septemspinosa* (Keller and Klein-MacPhee, 2000). The analysis compared the results of winter flounder trawl surveys near and away from the plant, and confirmed that winter flounder declines near Brayton Point are not apparent in other parts of Narragansett Bay. Although winter flounder stocks in other parts of the region have increased, stocks in Mount Hope Bay have not recovered in response to a fishing ban established in 1991, suggesting that fishing pressure alone did not cause the severe population decline in Mount Hope Bay.

To evaluate the potential benefits of the proposed rule, EPA estimated expected I&E at Brayton Point under current operations based on an analysis of I&E rates before the accelerated fish population declines that followed the 1984 conversion of unit 4, as discussed in Chapter F3. It should be noted that using the pre-1984 data still probably produces an underestimate of I&E levels because some data suggests that the plant contributed to a declining fishery before 1984, though the decline accelerated precipitously after 1984. Unfortunately there is no Mount Hope Bay abundance data from before Brayton Point Station began operations to provide a true baseline unaffected by the plant. Section F1-1 of this background chapter provides a brief description of the facility, Section F1-2 describes the facility's environmental setting, and Section F1-3 presents information on the area's socioeconomic characteristics.

F1-1 Overview of Case Study Facility

The Brayton Point Station is located on approximately 100 ha (250 acres) of the Brayton Point peninsula in Mount Hope Bay, at the confluence of the Lee and Taunton rivers (Figure F1-2). The facility lies within the Town of Somerset, and the city of Fall River is located across the Taunton River to the southeast of the facility. The city of Swansea is located across the Lee River to the north of the facility. The Massachusetts-Rhode Island state line runs diagonally across Mount Hope Bay, which is an upper embayment of the Narragansett Bay Estuary.

Figure F1-2: Location of Brayton Point Station in Mount Hope Bay



The Brayton Point power plant is in the Northeast Power Coordinating Council (NPCC). The plant began commercial service in 1963 and is operated as a baseload facility. Brayton Point operates eight units: three coal-fired steam-electric generators, one oil-fired steam-electric generator, and four internal combustion units. In 1998, Brayton Point generated 8.1 million MWh of electricity. Estimated 1998 revenues for the Brayton Point plant were $552 million, based on the plant's 1998 estimated electricity sales of 7.7 million MWh and the 1998 company-level electricity revenues of $71.38 per MWh. Brayton Point's 1998 production expenses totaled $211 million, or 2.602 cents per kWh, for an operating income of $341 million.[1]

Table F1-1 summarizes the plant characteristics of Brayton Point.

Table F1-1: Summary of Brayton Point Plant Characteristics (1998)

Plant EIA Code	1619
NERC Region	NPCC
Total Capacity (MW)	1,611
Primary Fuel	Coal
Number of Employees	320[a]
Net Generation (million MWh)	8.1
Estimated Revenues (million)	$552
Total Production Expense (million)	$211
Production Expense (¢/kWh)	2.602¢
Estimated Operating Income (million)	$341

Notes: NERC = North American Electric Reliability Council
NPCC = Northeast Power Coordinating Council
Dollars are in $2001.

[a] 1995 data.

Source: U.S. Department of Energy (2001c, 2001e, 2001f).

In response to the developing controversy, federal and state regulatory agencies and former plant owner NEPCO entered into a Memorandum of Agreement (MOA) in April, 1997, regarding plant operations. The MOA places annual and seasonal caps on the level of heat discharged and the amount of cooling water withdrawn from the Bay. In the MOA the Company agreed to limit its operations to levels below that authorized by the (still) current NPDES permit and the agencies agreed not to push for an immediate modification of the permit. (NEPCO had threatened to appeal any immediate permit modification anyway.) The intake volume and thermal discharge caps in the MOA represented a compromise between the levels initially sought by the regulatory agencies and the levels the company claimed were justified. The MOA also indicated that a number of types of research should be pursued to help with development of a new NPDES permit. When PG&E bought Brayton Point Station it assumed responsibility for complying with the MOA (the MOA required that agreement to comply with the MOA be made a condition of any sale of the plant). Since the 1997 MOA, the permittee and the regulatory agencies have been engaged in extensive monitoring, modeling and study to determine the conditions for a new NPDES permit.

On October 2, 2002, PG&E publicly announced a proposed $250,000,000 environmental improvement plan for the facility including new air pollution controls, ash recycling facilities, and a new cooling water system using mechanical draft wet cooling tower that PG&E refers to as the Enhanced Multi-Mode System. The Company intends this plan to address requirements under the new State air quality regulations, a State Administrative Consent Order addressing ash management practices, and the new NPDES permit. PG&E states that this new system will reduce heat loadings into Mount Hope Bay, and reduce cooling water withdrawals from Mount Hope Bay, to pre-1984 levels. The year 1984 is significant because it was the year that Brayton Point was permitted to switch Unit 4 from a previously closed-cycle cooling system to a once-through cooling system, and some data suggests that the steep decline in fish populations was coincidental with this modification. (As noted above, there is also data suggesting that the decline had started earlier but accelerated after Unit 4 began once-through cooling operations.)

[1] The generation, revenue, electricity sales, production expense, and operating income numbers in this section are based on FERC Form 1 data for the eight months during which the plant was operated as a regulated utility plant. EPA adjusted these values to represent the entire year using a scaling factor of 1.46 (equal to total 1998 generation divided by 8-month generation, or 8.12 million MWh/5.56 million MWh; total generation is based on U.S. Department of Energy, 2001b, 2001d).

EPA is working closely with Massachusetts and Rhode Island on the permit, and has also been coordinating with the National Marine Fisheries Service. The permit will be jointly issued with the state in Massachusetts which does not have NPDES delegation. EPA is also in close communication with the company regarding the issues and the company has submitted a substantial of information supporting its view of what limits should be in the new permit. EPA has also received significant communications from interested environmental groups. In addition, there has been congressional interest in both Massachusetts and Rhode Island as well as statements of concern by the Governor of Rhode Island. Public interest in the permit development is high. Over the past year serious concerns have been raised by groups including Save the Bay, Conservation Law Foundation, the Rhode Island Salt Water Anglers, and the New England Fishery Management Council. Also, the Rhode Island Attorney General has also been actively engaged in tracking the matter and has publicly threatened to sue the company over damage to Rhode Island's natural resources. Finally, the permit issues have received substantial attention in local major media outlets, including a recent front page story in the Boston Globe.

❖ ***Ownership information***

Brayton Point began operation as a regulated utility plant and is currently owned by USGen New England Inc., an affiliate of PG&E National Energy Group. Brayton Point was purchased by PG&E Generating Co. from the New England Power Company (NEPCO) in 1998. Brayton Point is currently operated as a merchant generating plant, selling electricity in the deregulated wholesale generation market (Standard & Poor's, 2001b).

PG&E Corporation is one of the largest utility holding companies in the United States, with ownership of or control over approximately 18,000 MW of electric generating capacity and electricity sales of over 80 million MWh in 2000. PG&E Corporation had 20,850 employees and sales of over $26 billion in 2000. However, PG&E Corporation suffered substantial financial losses as a result of the California energy crisis, when its regulated operations subsidiary, Pacific Gas and Electric Company, which serves several million electric and gas customers in Central and Northern California, was unable to pass rising wholesale power prices on to retail consumers. As a result, Pacific Gas and Electric Company, as a subsidiary only but not as PG&E Corporation, filed for Chapter 11 bankruptcy protection in April 2001 (Hoover's Online, 2001h; PG&E, 2001; Standard & Poor's, 2001b).

F1-2 Environmental Setting

F1-2.1 Mount Hope Bay

Mount Hope Bay is an upper embayment in the northeast portion of the Narragansett Bay Estuary, which was designated as an "Estuary of National Significance" by the U.S. Congress in 1987 (NBC, 2001) (Figure 2-1). It is about 10 km (6 miles long), covering 40 km^2 (15.6 square miles) (NBC, 2001). The bottom of the bay is predominantly sandy, and depths average approximately 5.5 m (18 ft) at mean low water. The state line between Massachusetts and Rhode Island runs from southeast to northwest across the bay, such that the lower portion falls in Rhode Island.

Circulation of water in the bay is dominated by tidal flow, with average tidal amplitude of 1.3 m (4.4 ft) (NBC, 2001). The Narragansett Bay estuary has free connection with the open sea, and within it, freshwater from land drainage dilutes sea water.

F1-2.2 Aquatic Habitat and Biota

The Narragansett Bay Estuary consists of a variety of habitats. Salt marshes, seagrass beds, oyster beds, cobble bottoms, soft bottoms, tidal flats, beaches, rocky shores, and the open water are all essential elements of the bay ecosystem (NBEP, 1998). Of particular importance is eelgrass habitat. Eelgrass is a rooted plant that grows densely in shallow coastal waters, in what are called "eelgrass meadows." It provides food, shelter, and spawning habitat for an abundance of marine life, including economically important finfish and shellfish species such as winter flounder, tautog , bluefish (*Pomatomus saltator*), American oyster (*Crassostrea virginica*), northern quahogs or hard clams (*Mercenaria mercenaria)*, bay scallops (*Argopecten irradians*), soft-shelled clams (*Argopecten irradians*), American lobster (*Homarus americanus*), and blue crab (*Callinectes sapidus* Rathbun) (NBEP, 1998; DeAlteris et al., 2000).

The fish community of Mount Hope Bay is estuarine with coastal migrant fishes. Vast numbers of fish migrate in and out of Mount Hope Bay in seasonal patterns (NBC, 2001). Approximately 60 species of adult fishes have been identified in the bay. Truly local species include silverside (*Menidia menidia*), northern pipefish (*Syngnathus fuscus*), fourbeard rockling *(Enchelyopus cimbrius*), and seaboard goby (*Gobiosoma ginsburgi*). Local migrants, which move freely within Narragansett Bay and probably into the adjacent sounds, are winter flounder, windowpane (*Scophthalmus aquosus*), tautog, and searobin (*Triglidae*). Truly migratory species include Atlantic menhaden (*Brevoortia tyrannus*), weakfish (*Cynoscion regalis*), butterfish (*Peprilus triacanthus*), scup (*Stenotomus chrysops*), and bay anchovy (*Anchoa mitchilli*). Many of the prominent

Narragansett fish species, including striped bass (*Morone saxatilis*), bluefish, tautog, winter flounder, summer flounder/fluke (*Paralichthys dentatus*), scup and weakfish, are highly sought after by both commercial and recreational fishermen (NBEP, 1998).

Narragansett Bay is also home to waterfowl and wading birds. Over 350 species of birds have been spotted in the bay's environs (NBC, 2001). Species such as mergansers *(Mergus meraganser*), buffleheads (*Bucephala albeola*), and great blue herons (Ardea herodias) can be found in the bay during various seasons (NBEP, 1998).

Benthic organisms that inhabit the bay include clams, quahogs, crabs, lobsters, snails, shrimps, and sponges. The dominant intertidal organisms in the rocky surfaces include the blue mussel, snail, and barnacles. Soft bottom communities are composed primarily of bivalves, amphipods, and polychaete worms (NBC, 2001).

Endangered species that live or feed in Narragansett Bay include diamond-back terrapin (*Malaclemys terrapin*), roseate tern (*Sterna dougallii*), and Kemp's ridley turtle (*Lepidochelys kempii)* (NBEP, 1998).

F1-2.3 Major Environmental Stressors

a. Habitat alteration

Water pollution, dredging, coastal development, and other environmental stressors have nearly eliminated eelgrass in Mount Hope Bay (NBEP, 1998). Though upper Narragansett Bay once supported extensive seagrass beds, they are now present only in the southern half of the bay. The vitality of an estuary's eelgrass beds is widely recognized as an indicator of an estuary's ecological health (Save the Bay, 2001).

The once abundant fish, shellfish, and birds that depend on eelgrass meadows have declined in number, because of habitat alteration and other stressors. Bay scallops began to decline in the 1950's and have yet to recover. Similarly, winter flounder, once one of the bay's most important catches, has declined precipitously over the past decade.

b. Overfishing

Fishery landings and stock sizes of many Narragansett Bay fish and shellfish species have changed dramatically (DeAlteris et al., 2000). The oyster harvest peaked at 6.8 million kg (15 million lb) in 1910, and then declined to less than 4,000 kg (10,000 lb) from 1955 to 1996. Landings of the northern quahog peaked at 2.3 million kg (5 million lb) in 1955 and then declined to less than 0.5 million kg (1 million lb) in 1998. In contrast, lobster landings have steadily increased from less than 0.05 million kg (0.1 million lb) in the early 1950's to more than 3.4 million kg (7.5 million lb) in the early 1990's. Winter flounder landings steadily increased from less than 0.2 million kg (0.5 million lb) in the 1940's to over 4 million kg (9 million lb) in the early 1980's, but then declined to about 0.5 million kg (1 million lb) in the late 1990's. Striped bass landings have fluctuated widely in the last 50 years; the fishery collapsed in the late 1970's, and then increased to almost 0.5 million kg (1 million lb) in the mid-1990's (DeAlteris et al., 2000).

c. Pollution

Narragansett Bay is one of the most densely populated estuarine systems in the country (Caton, 2001). As a result, the bay must assimilate high levels of industrially derived toxic pollutants, nutrients, and wastewater runoff from the area's 33 wastewater treatment facilities (WWTF).

In addition, large amounts of heat are discharged into Mount Hope Bay by Brayton Point and into the Taunton River, albeit at lesser amounts, by facilities such as Taunton Municipal and Montaup Station.

Based on 1990 census figures, it is estimated that 0.5 million m^3 (125 million gallons) of wastewater are either directly or indirectly discharged into Narragansett Bay each day (Caton, 2001). The greatest pollution levels can be found at the head of the bay where the metropolitan areas of Providence, Worcester, and Fall River dispose of their wastewater. Excessive levels of human waste have a number of effects on aquatic life and the recreational and commercial uses of Narragansett Bay. Of primary concern are the low levels of dissolved oxygen caused by large nutrient loadings from the WWTFs. Nitrogen discharged by facilities causes excess plant growth (algal blooms). When the algae die, they are decomposed by bacteria that consume dissolved oxygen, effectively suffocating fish and other wildlife. Similarly, bacterial nitrification of ammonia discharged by WWTFs also depletes the bay's waters of dissolved oxygen, making many waters uninhabitable (Caton, 2001).

Human sewage is also responsible for temporary and permanent closures of over 31 percent of Narragansett Bay to shellfish harvesting (Caton, 2001). Portions of Mount Hope Bay have been permanently closed to shellfish harvesting since the

1940's, and other portions are routinely closed after heavy rains cause overflow of sewage waters. Fall River is presently working on a multi-million dollar combined sewer outflow abatement program, having already made improvements to its WWTF.

Narragansett Bay also suffers from industrial toxic pollutants (Caton, 2001). Traces of industrial metals (copper, zinc, iron, mercury) and organic compounds (PCBs, PHCs, pesticides) are found in bay sediments, creating potential health risks primarily through the consumption of contaminated seafood. However, the discharge of these pollutants into the bay has decreased dramatically because of the pretreatment of industrial wastewater (NBEP, 1998).

d. Climate change

Winter water temperatures in Narragansett Bay have increased markedly over the past 40 years. Likely causes include global warming (Keller and Klein-MacPhee, 2000) and the discharge of waste heat into the bay by Brayton Point Station. This has resulted in a loss of the usual winter-spring diatom bloom, with potential impacts on higher trophic levels because of changes in prey availability (Keller et al., 1999). Warmer water in winter may also increase predation rates by the shrimp *Crangon septemspinosa* on larval winter flounder, contributing to recent population declines (Keller and Klein-MacPhee, 2000).

e. Surface water withdrawals by CWIS

Steam electric power generation accounts for the single largest intake of water from the Narragansett Bay watershed, amounting to over 85 percent of all surface water withdrawals, and 100 percent of all saline water withdrawals (USGS, 1995).

F1-3 SOCIOECONOMIC CHARACTERISTICS

Bristol County has a population of 534,678 (Table F1-2; U.S. Census Bureau, 2001), of which 18,234 live in the Town of Somerset. The county has four cities (Attleboro, Fall River, New Bedford, and Taunton) and 16 towns (BCCVB, 2002).

Table F1-2: Socioeconomic Characteristics of Bristol County, Massachusetts, and the State of Massachusetts

	Bristol County	Massachusetts	Rhode Island
Population	534,678	6,349,097	1,048,319
Land area (square miles)	556	7,840	1,045
Persons per square mile	961.7	809.8	1,003.2
Median household money income (1997 model-based estimate)	$38,866	$43,015	$36,699
Persons below poverty (%, 1997 model-based estimate)	11.9%	10.7%	11.2%
Housing units	216,918	2,621,989	439,837
Home ownership rate	61.6%	61.7%	60%
Households	205,411	2,443,580	408,424
Persons per household	2.54	2.51	2.47
Households with persons under 18 years (%)	35.6%	32.9%	32.9
High school graduates, persons 25 years and over (1990 data)	213,057	3,169,566	474,612
College graduates, persons 25 years and over (1990 data)	52,143	1,078,999	140,160

Data from 2000 except where shown.
Source: U.S. Census Bureau, 2001.

F1-3.1 Major Industrial Activities

Narragansett Bay hosts a wide range of water-dependent industries, including recreation, shipbuilding, fishing, fish processing, shipping, and military. Other industries such as electronics, magazines, and auto imports also benefit from maritime access through Narragansett Bay.

The Town of Somerset is a suburban township with some small-scale resort and second home development. It has 24 km (15 miles) of waterfront, which are primarily used for recreation. The closest city, Fall River, has more industrial activities with chemical operations, electrical and food products along with the garment and textile industries. It also draws tourism with the largest factory outlet district in New England and a World War II memorial (MDHCD, 2001).

F1-3.2 Commercial Fisheries

Commercial fishing has long been a staple activity in Narragansett Bay. In 1999, the total value of Rhode Island's commercial landings of fish and shellfish was approximately $79 million (RIEDC, 2000), and the total value of Massachusetts' commercial landings was about $260.5 million (NMFS, 2001a). It is estimated that Narragansett Bay accounts for 25-75 percent of Rhode Island's shellfish landings, 5 percent of finfish landings, and 10-25 percent of lobster landings (DeAlteris et al., 2000). The upper bay, near Brayton Point, is a major fishing area for quahogs. Narragansett Bay produces about 8 million pounds of quahogs annually, with a landed value of $6 million (NBC, 2001).

The Narragansett Bay commercial fishing industry supports a number of other fishing-related industries, including fish processing and the manufacture of commercial fishing equipment (NBC, 2001).

F1-3.3 Recreation

Narragansett Bay's most important economic activities are tourism and recreation. Outdoor recreation, including fishing, generates an estimated $2 billion in revenues each year (NBEP, 2001).

a. Recreational fishing

More than 100,000 people fish on Narragansett Bay each year. Over 32,000 recreational boats are registered on the bay, and many more are trailered from out of state. The bay's recreational fishery is valued at more than $300 million per year (NBEP, 2001).

b. Other water-based recreation

Narragansett Bay supports a great deal of other water-based recreation as well (RIEDC, 1999). Pleasure boating is especially popular, and many races and regattas are held in the summer season. Rhode Island has over 85 marinas, 28 yacht clubs, approximately 100 public boat launching sites, and over 50 charter and pleasure boats. There are also over 100 swimming beaches, and camping, picnicking, surfing, and diving are popular activities.